

REMARKS

This is intended as a full and complete response to the Final Office Action dated May 16, 2002. Claims 1, 3, 8, and 10-40 are pending in the application and stand rejected. Applicants have amended claims 32 and 37 to correct a grammatical error; therefore, these amendments are not directed to the patentability of the claims. Please enter these amendments and reconsider the claims for reasons discussed below.

Claims 1, 3, 5, 6, 7, 24-25, and 27-30 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Konecni et al.* (EP 0849 779 A2). Claims 1, 3, 5, 6, 7, 24-25, 27-30 also stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Tran et al.* (U.S. Patent No. 5,534,445). The Examiner states that neither *Konecni et al.* nor *Tran et al.* specifically disclose the percent by volume of argon as recited in the claims, but that "it is well known in the art that etching parameters, such as etchant concentration, temperature, and flow rate, affect both the rate and quality of the plasma etching process."

Applicants respectfully traverse these rejections. Applicants have previously pointed out that the claimed invention achieves unexpected and surprising results over the prior art. The claimed invention provides a method for processing a substrate in a processing chamber that enhances the etch rate of the substrate by exposing the substrate to a plasma generated from a gas mixture consisting of argon, helium and hydrogen wherein the helium content of the plasma is increased to increase the etch rate of the patterned substrate surface. (See, specification at page 5, lines 24-31 and Figure 4.) The volume of helium is increased as the volume of argon decreases. Figure 4 of the application shows that the etch rate increased as the volume of argon decreased from 75% by volume to 25% by volume, i.e. the volume of helium is increased. This correlation is contrary to expectations. One would have expected the etch rate to decrease as the volume of argon within the plasma decreased. The claimed invention is contrary to what would have been expected by one having ordinary skill in the art and thus, nonobvious in view of the prior art. Accordingly, Applicants respectfully request withdrawal of the rejection.

The Examiner states that this evidence of nonobviousness is not commensurate in scope with the claims. Applicants respectfully disagree. Figure 4 shows that the etch rate increased as the volume of argon decreased from 75% by volume to 25% by volume. The specification (page 9) shows argon was mixed with a mixture of He and 5% H₂. Decreasing the argon from 75% to 25% therefore necessarily increases the percentage of He. The volume of helium increased as the volume of argon decreased within the mixture of argon, helium, and hydrogen that was used to generate Figure 4. For these reasons, the showing of unexpected results are commensurate in scope to the claims, and Applicants respectfully request withdrawal of the rejections and allowance of the claims.

Furthermore, Applicants still disagree with the Examiner's assertion that "it is well known in the art that etching parameters, such as etchant concentration, temperature, and flow rate, affect both the rate and quality of the plasma etching process." The Examiner cited *Guinn et al.* (U.S. Patent No. 5,877,032) at column 4, lines 1-15, to support this assertion. First, *Guinn et al.* teaches an etch process using a plasma of fluorocarbons, specifically C₂F₆, not a gas mixture consisting of argon, helium and hydrogen as recited in the claims. (See, *Guinn et al.* at col. 2, lines 34-67.) Secondly, *Guinn et al.* teaches that:

A discrete processing parameter (e.g. temperature, flow rate, pressure, rf bias, source power, O₂ clean time) is varied to change the etch rate of the photoresist and/or the contact hole. The parameters selected for variation, and the amount by which the parameters are varied, are selected to obtain traces over a range of etch rates. Therefore, only parameters that effect the etch rate when varied are selected for this purpose. (See, *Guinn et al.* at col. 4, lines 3-11.)

Contrary to the Examiner's assertion, *Guinn et al.* does not teach increasing an etch rate. *Guinn et al.* merely teaches that an etch rate can be varied. *Guinn et al.* does not state which processing parameter, if any at all, had a direct effect on the etch rate. *Guinn et al.* merely teaches that parameters that do affect the etch rate, when

varied, are selected. Further, *Guinn et al.* does not teach, show, or suggest that varying a discrete processing parameter would "affect ... the ... quality of the plasma etching process", as asserted by the Examiner. *Guinn et al.* merely teaches changing the etch rate. *Guinn et al.* teaches nothing about the quality of the plasma etching process.

Therefore, neither the Examiner nor *Guinn et al.* has provided evidence as to which parameter or parameters, if any at all, are result-effective variables. A particular parameter must first be recognized as a result-effective variable, i.e. a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation. *In re Antoine*, 559 F.2d 618, 195USPQ 6 (CCPA 1977). See also *In re Bosch*, 617 F.2d 272, 205 USPQ 215 (CCPA 1980). Accordingly, withdrawal of the rejection and allowance of the claims is respectfully requested.

Claims 4, 8, 10-23, and 26 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Konecni et al.* (EP 0849 779 A2) in view of *Kennard* (U.S. Patent No. 5,935,874). Claims 4, 8, 10-23, and 26 also stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Tran et al.* (US 5,534,445) in view of *Kennard* (U.S. Patent No. 5,935,874). Claims 31-40 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Konecni et al.* (EP 0849 779 A2) in view of *Kennard* (U.S. Patent No. 5,935,874).

The Examiner states that neither *Konecni et al.* nor *Tran et al.* specifically discloses the step of increasing the helium content/flow rate to increase etching of the patterned substrate surface. However, the Examiner states that *Kennard* discloses a method for plasma etching a trench comprising the step of "adding/increasing" a flow volume of helium to a gas mixture chemistry. The Examiner, therefore, asserts that it would have been obvious to modify *Konecni et al./Tran et al.* by increasing the helium content/flow rate to the gas mixture as per *Kennard* "especially because *Kennard* teaches that it is believed that the addition of a relatively high flow volume of helium improves the directionality of the etch by increasing the ion energy, thereby increasing the vertical etch rate into the trench."

Applicants respectfully traverse these rejections. *Kennard* teaches a method for etching a trench in a monocrystal silicon layer by adding a "relatively" high flow rate of

helium to an oxygen/fluorine-based etchant gas, not a gas mixture consisting of argon, helium and hydrogen as recited in the claims. (See, *Kennard* at col. 3, lines 54-61). *Kennard* does not teach, show, or suggest increasing the helium content to increase etching of the patterned substrate surface, as recited in claims 4, 8, 10-23, 26, and new claims 31-35. *Konecni et al.* and *Tran et al.* have been distinguished above.

Applicants submit that the Examiner has mistakenly taken *Kennard's* teaching of "adding" to be a teaching of "increasing", which is recited in the claims. "Adding" and "increasing" are different concepts that are patentably distinct. Therefore, a combination of the references does not teach, show, or suggest increasing the helium content to increase etching of the patterned substrate surface, as recited in claims 4, 8, 10-23, 26, and 31-40. Withdrawal of the rejections and allowance of the claims is respectfully requested.

In conclusion, the references cited by the Examiner, neither alone nor in combination, teach, show, or suggest the claimed invention. Having addressed all issues set out in the office action, applicants respectfully submit that the claims are in condition for allowance and respectfully request that the claims be allowed.

Respectfully submitted,



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APPENDIX

Claims 32 and 37 have been amended as follows:

32. (Amended) The method of claim 31, wherein the patterned substrate comprises a feature having an aspect ratio [great] greater than about 4 to 1.

37. (Amended) The method of claim 36, wherein the patterned substrate comprises a feature having an aspect ratio [great] greater than about 4 to 1.